Development of Design Practices for PV/Battery Remote Area Power Supplies (RAPS)

Edward G. Skolnik, Christina Y. TerMaath
Energetics Incorporated
and
Paul C. Butler
Sandia National Laboratories

DOE Energy Storage Program Review
Crystal City, VA
November 15, 2001

Why RAPS Standards/Design Practices?

Objective

- Support development and facilitate coordination of standards and recommended practices for RAPS, concentrating on the storage system
  - IEEE Standards Coordinating Committee 21 (SCC21)- Energy Storage Working Group

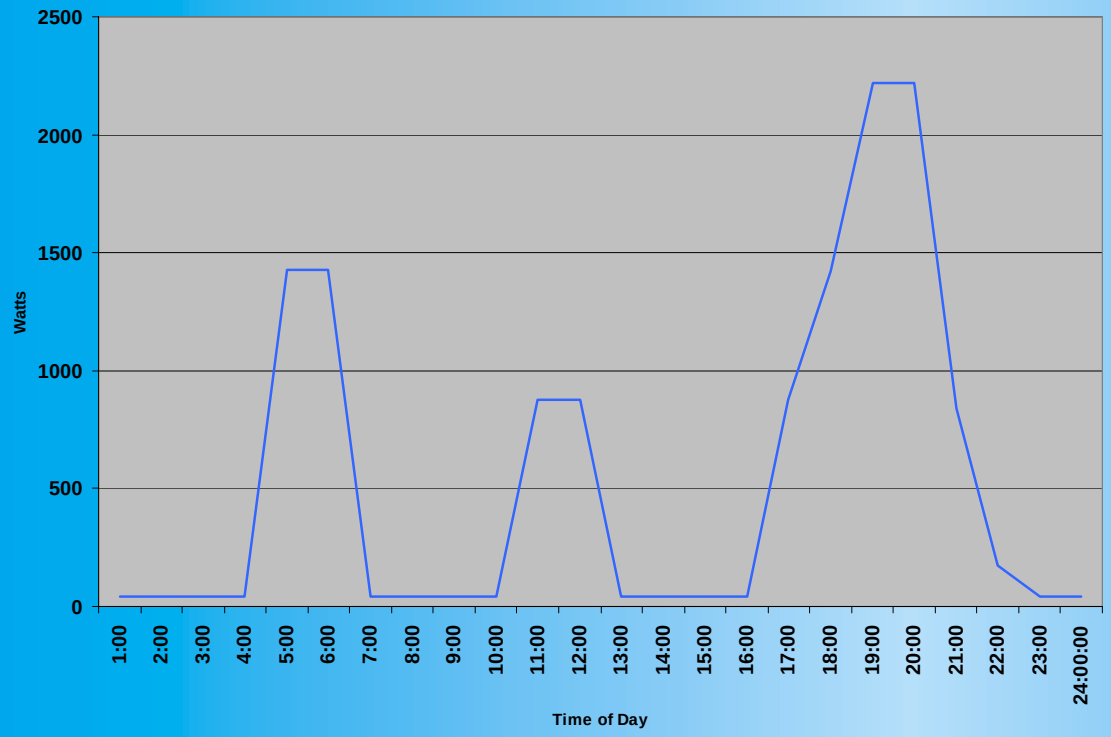
Purpose

- Enable renewable generation options in remote areas
- Address the lack of standards and recommended practices for storage components

Past RAPS Efforts (since 1997)

- Work with standards committees and groups
  - SCC21 Energy Storage Working Group
  - International Lead-Zinc Research Organization (ILZRO)-RAPS Test Committee
  - Monitoring of other standards groups: SCC29, Power Energy Society- battery sub-group, IEC
  - * **Found that working with/supporting SCC21 provides the best venue for accomplishing goals**
- Loads and Resources Research
  - Constructed database of over 70 RAPS sites
  - Identified load profiles of several home and village RAPS sites
  - Identified “typical” village profiles
  - Developed curve fitting equations for load profiles
  - * **Information will be used in hybrid design practices document**

Typical Village Load Profile: Hyderabad, India



- **Profile similar in shape to single home profiles**

- **~ 60 Homes**
- **~ 300 People**
- **Street Lights**
- **Community Center**
- **Health Center**
- **Water Pump**

Current Tasks

- Actively support and participate in the Energy Storage Working Group of IEEE's SCC21
  - Provide technical and secretarial support
  - Provide input to working documents
  - Distribute meeting information
- Facilitate communication among members of the working group
  - Create a website

Energy Storage Working Group Activities

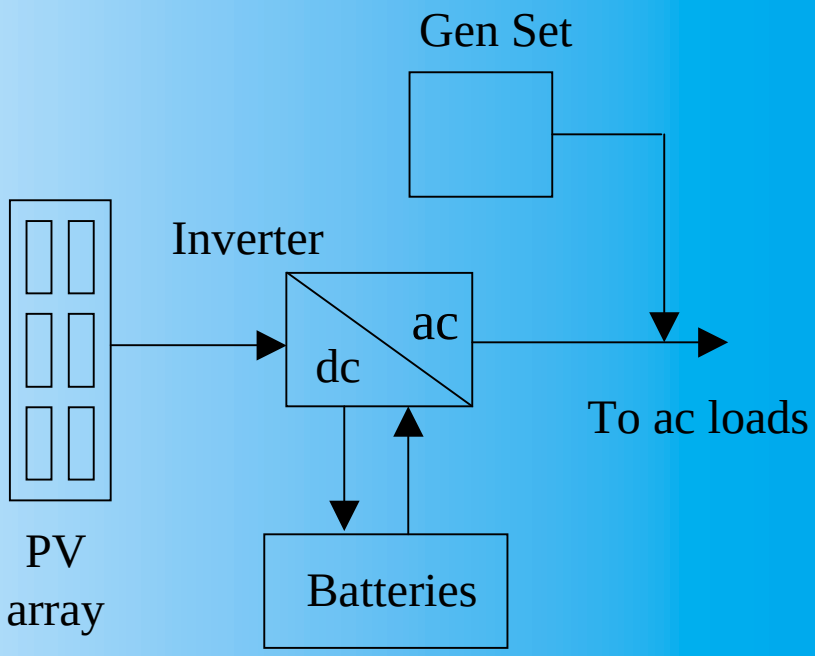
- Published four Recommended Practices involving the sizing, installation, and maintenance of lead-acid and nickel/cadmium batteries in PV applications
- Developing two Guides for the use of lead-acid batteries
  - Hybrid RAPS Systems (PAR 1561)
  - Stand-Alone PV Systems (PAR 1361)
- Coordinating activities with IEEE SCC29 (Batteries) and Power Engineering Society

Developing PAR 1561

Lead author: Carl Parker, ILZRO

Status: Fourth working draft

Objective: To provide guidance in the design and operation of lead-acid batteries to improve their performance and life in hybrid RAPS applications



Advantages of Hybrid System

PV and diesel systems are complementary

Characteristic	PV-Generation	Diesel-Generation
Dependence on natural cycles	Highly dependent	Usually independent
Size range	Best for low kWh/day loads	Best for high kWh/day loads
Reliability	Resource constrained, Otherwise, excellent	Hindered by complexity and fuel availability
Fuel requirement	None	Proportional to load, requires periodic deliveries
Maintenance	Infrequent	Frequent
Battery charging rate	Typically constrained	Typically less constrained
Initial cost per watt	Relatively high	Relatively low
Operating costs	Relatively low	Relatively high

Technical Topics Addressed in PAR 1561

Safety and environmental issues: safety procedures, electrolyte and electrical hazards, handling and fire hazards, protective equipment

Battery installation, design, and procedures: location, electrical connections, acceptance testing

Battery management and operations: water loss, sizing, charging/discharging, equalization, control parameters

System Operations: set points, monitoring, load shedding

Maintenance: preventive and corrective action

Troubleshooting: capacity loss, water consumption, voltage drops, excess voltage fluctuation

Developing PAR 1361

Lead Author: Tom Hund,
Sandia National Laboratories

Status: Draft thirteen

Objective: To provide a test procedure to evaluate battery performance and charge parameters, allowing appropriate selection and operation of the battery in PV applications

Technical Topics Addressed in PAR 1361

Safety: arc hazard, hydrogen venting, secondary containment

Battery selection: battery characteristics and parameters

Recommended test plan: equipment, data acquisition, procedures for capacity and cycle testing, battery recharge

Evaluation of test results: interpretation of results

Battery tutorial information: types, applications, operations, characteristics

Energy Storage Working Group Website

Goal

- Increase communication among energy storage members
- Share information about the group's activities

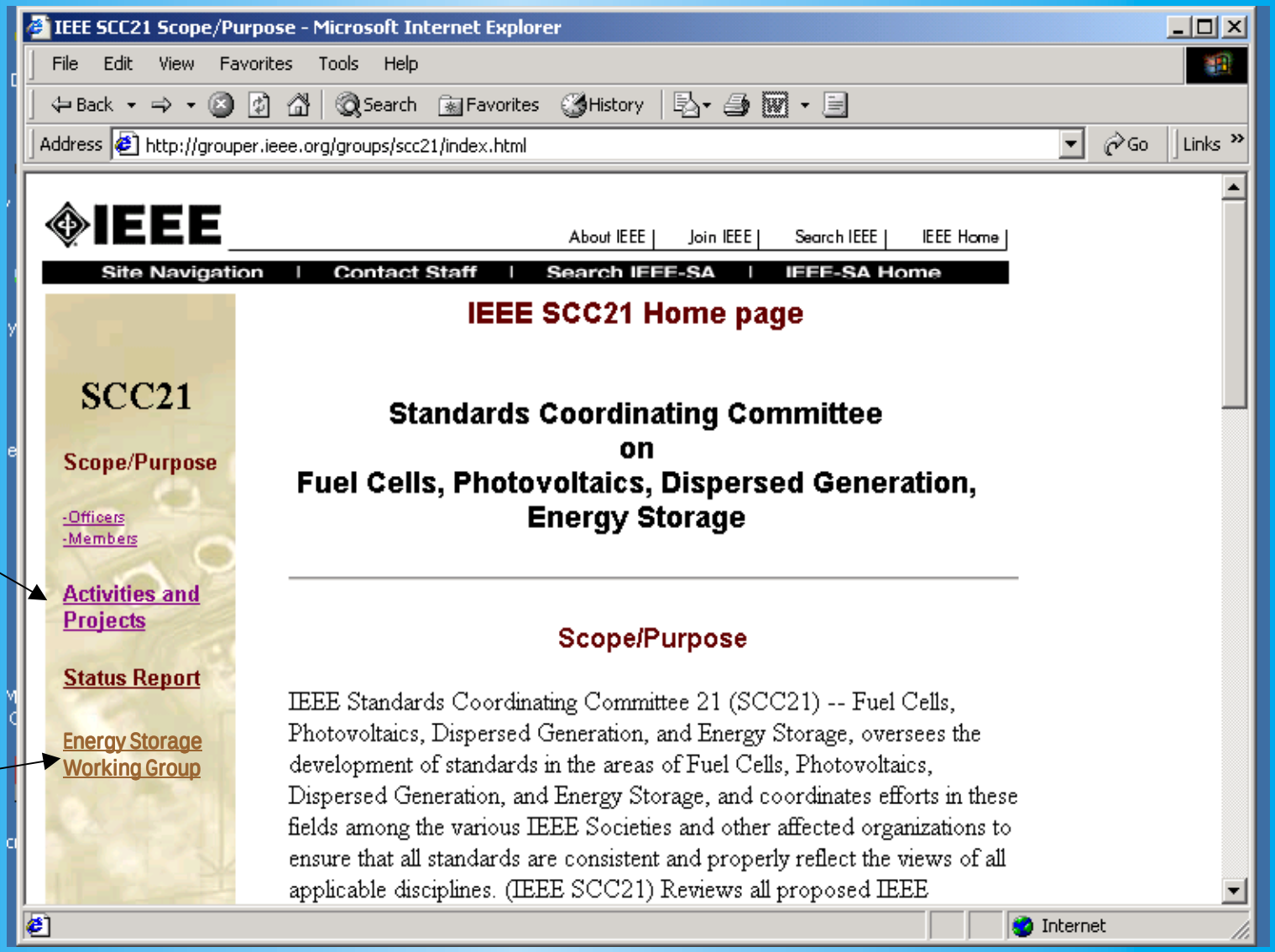
Planned Content

- Updated versions of working documents
- Comments/suggestions area for each document
- Information about upcoming meetings
- Meeting minutes
- Member lists

IEEE SCC21 Home Page

Link to working documents

Link to energy storage working group info



Energy Storage Website Outline

SCC21 Energy Storage Working Group

Current Activities
Members
Meeting Minutes
Next Meeting

IEEE SCC21 Energy Storage Working Group Home Page

Current Activities

The SCC21 Energy Storage Working Group is working on several standards and guides related to stand alone photovoltaic systems…

Members

A list of members and their contact information can be found here.

Meeting Minutes

October 16-18, 2001 Las Vegas, NV
May 23-25, 2001 Las Cruces, NM
January 29 – February 2, 2001 Cocoa, FL
June 19-20, 2000 Golden, CO

Next Meeting

February, 2002 Location TBD

Documents

Site Navigation | Contact Staff | Search IEEE-SA | IEEE-SA Home

SCC21 Activities and Projects

IEEE P937, Draft Recommended Practice for Installation and Maintenance of Lead-Acid Batteries for Photovoltaic (PV) Systems

IEEE P1013, Draft Recommended Practice for Sizing Lead-Acid Batteries for Photovoltaic (PV) Systems

IEEE P1547, Draft Standard for Interconnecting Distributed Resources with Electric Power Systems

IEEE P1589, Draft Standard for Conformance Tests Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems

IEEE P1561, Recommended Guide for Optimizing the Performance and Life of Lead-Acid Batteries in hybrid Remote Area Power Supply Systems

IEEE P1361, Guide for Selection, Charging, Test and Evaluation of Lead-Acid Batteries Used in Stand-Alone Photovoltaic Systems

Links to energy storage documents

Future Plans

- Continue support of SCC21
- Consider Recommended Practices for other resources
  - e.g., stand-alone wind/battery and/or stand-alone PV/Wind/Battery
- Other load-types
  - e.g., telecommunications systems, residential systems
- Other types of storage
  - Adv. Batteries, FES, SMES
- Consider an analysis of hybrid systems for distributed energy involving renewable/hydrogen storage/battery storage/fuel cell or microturbine